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Measurement of differential top-quark pair production cross sections in pp collisions at $\sqrt{s} = 7\,\text{TeV}$

—Supplemental Material—

The CMS Collaboration

Abstract

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Normalised Differential Cross Section Values

Table 1: Normalised differential $\mathrm{t\bar{t}}$ cross section as a function of lepton observables in the ℓ+jets channels: the transverse momentum of the leptons p_{T}^{ℓ} and the pseudorapidity of the leptons η^{ℓ}.

p_{T}^{ℓ} bin [GeV]	$1/\sigma\,\mathrm{d}\sigma/\mathrm{d}p_{\mathrm{T}}^{\ell}$	stat. [%]	sys. [%]	total [%]
30 to 35	$2.25 \cdot 10^{-2}$	2.4	6.1	6.6
35 to 40	$2.24 \cdot 10^{-2}$	2.5	3.8	4.6
40 to 45	$2.12 \cdot 10^{-2}$	2.5	6.0	6.5
45 to 50	$1.88 \cdot 10^{-2}$	2.6	3.7	4.6
50 to 60	$1.50 \cdot 10^{-2}$	2.1	2.2	3.0
60 to 70	$1.14 \cdot 10^{-2}$	2.3	3.6	4.3
70 to 80	$0.90 \cdot 10^{-2}$	2.5	4.3	5.0
80 to 100	$0.53 \cdot 10^{-2}$	2.4	3.7	4.4
100 to 120	$0.27 \cdot 10^{-2}$	3.3	5.6	6.5
120 to 150	$0.12 \cdot 10^{-2}$	3.9	5.6	6.8
150 to 200	$0.04 \cdot 10^{-2}$	5.8	8.5	10.3
η^{ℓ} bin	$1/\sigma\,\mathrm{d}\sigma/\mathrm{d}\eta^{\ell}$	stat. [%]	sys. [%]	total [%]
-2.1 to -1.8	$0.83 \cdot 10^{-1}$	5.4	10.0	11.4
-1.8 to -1.5	$1.35 \cdot 10^{-1}$	4.1	6.1	7.4
-1.5 to -1.2	$1.74 \cdot 10^{-1}$	3.3	8.3	8.9
-1.2 to -0.9	$2.54 \cdot 10^{-1}$	2.8	4.2	5.1
-0.9 to -0.6	$3.03 \cdot 10^{-1}$	2.4	4.2	4.8
-0.6 to -0.3	$3.49 \cdot 10^{-1}$	2.2	2.9	3.6
-0.3 to 0.0	$3.52 \cdot 10^{-1}$	2.3	3.8	4.4
0.0 to 0.3	$3.68 \cdot 10^{-1}$	2.3	3.2	3.9
0.3 to 0.6	$3.57 \cdot 10^{-1}$	2.2	3.4	4.0
0.6 to 0.9	$3.11 \cdot 10^{-1}$	2.3	2.2	3.2
0.9 to 1.2	$2.34 \cdot 10^{-1}$	2.7	4.3	5.1
1.2 to 1.5	$1.95 \cdot 10^{-1}$	3.2	6.8	7.5
1.5 to 1.8	$1.41 \cdot 10^{-1}$	4.1	5.1	6.5
1.8 to 2.1	$0.77 \cdot 10^{-1}$	5.4	12.8	13.9

Table 2: Normalised differential $\mathrm{t\bar{t}}$ cross section as a function of b-jet observables in the ℓ+jets channels: the transverse momentum of the b jets $p_{\mathrm{T}}^{\mathrm{b}}$ and the pseudorapidity of the b jets η^{b}.

$p_{\mathrm{T}}^{\mathrm{b}}$ bin [GeV]	$1/\sigma\,\mathrm{d}\sigma/\mathrm{d}p_{\mathrm{T}}^{\mathrm{b}}$	stat. [%]	sys. [%]	total [%]
30 to 60	$1.35 \cdot 10^{-2}$	1.0	4.5	4.6
60 to 95	$0.96 \cdot 10^{-2}$	1.3	2.6	2.9
95 to 140	$0.38 \cdot 10^{-2}$	1.8	3.6	4.0
140 to 200	$0.11 \cdot 10^{-2}$	2.6	9.7	10.0
200 to 400	$0.01 \cdot 10^{-2}$	5.3	16.3	17.1
η^{b} bin	$1/\sigma\,\mathrm{d}\sigma/\mathrm{d}\eta^{\mathrm{b}}$	stat. [%]	sys. [%]	total [%]
-2.4 to -1.5	$1.01 \cdot 10^{-1}$	2.1	4.2	4.7
-1.5 to -1.0	$2.01 \cdot 10^{-1}$	1.7	2.8	3.3
-1.0 to -0.5	$2.86 \cdot 10^{-1}$	1.4	2.2	2.6
-0.5 to 0.0	$3.39 \cdot 10^{-1}$	1.3	2.5	2.8
0.0 to 0.5	$3.30 \cdot 10^{-1}$	1.3	3.2	3.5
0.5 to 1.0	$2.84 \cdot 10^{-1}$	1.5	3.0	3.3
1.5 to 1.5	$2.06 \cdot 10^{-1}$	1.8	2.6	3.1
1.6 to 2.4	$0.95 \cdot 10^{-1}$	2.1	6.1	6.5

Table 3: Normalised differential $t\bar{t}$ cross section as a function of top quark observables in the ℓ+jets channels: the transverse momentum of the top quarks p_T^t, the rapidity of the top quarks y^t, the transverse momentum of the top-quark pair $p_T^{t\bar{t}}$, the rapidity of the top-quark pair $y^{t\bar{t}}$, and the invariant mass of the top-quark pair $m^{t\bar{t}}$.

p_T^t bin [GeV]	$1/\sigma\, d\sigma/dp_T^t$	stat. [%]	sys. [%]	total [%]
0 to 60	$4.54 \cdot 10^{-3}$	2.5	3.6	4.4
60 to 100	$6.66 \cdot 10^{-3}$	2.4	4.9	5.5
100 to 150	$4.74 \cdot 10^{-3}$	2.4	3.2	4.0
150 to 200	$2.50 \cdot 10^{-3}$	2.6	5.1	5.8
200 to 260	$1.04 \cdot 10^{-3}$	2.9	5.5	6.2
260 to 320	$0.38 \cdot 10^{-3}$	3.7	8.2	9.0
320 to 400	$0.12 \cdot 10^{-3}$	5.8	9.5	11.1
y^t bin	$1/\sigma\, d\sigma/dy^t$	stat. [%]	sys. [%]	total [%]
$-2.$ to -1.6	$0.65 \cdot 10^{-1}$	5.1	10.3	11.5
$-1.$ to -1.2	$1.73 \cdot 10^{-1}$	2.9	5.9	6.6
$-1.$ to -0.8	$2.62 \cdot 10^{-1}$	2.8	4.1	5.0
$-0.$ to -0.4	$3.16 \cdot 10^{-1}$	2.6	3.8	4.6
$-0.$ to 0.0	$3.34 \cdot 10^{-1}$	2.7	4.8	5.5
0. to 0.4	$3.58 \cdot 10^{-1}$	2.5	2.6	3.6
0. to 0.8	$3.27 \cdot 10^{-1}$	2.5	5.2	5.8
0. to 1.2	$2.56 \cdot 10^{-1}$	2.7	5.0	5.7
1. to 1.6	$1.68 \cdot 10^{-1}$	3.0	5.7	6.4
1. to 2.5	$0.64 \cdot 10^{-1}$	5.0	7.1	8.7
$p_T^{t\bar{t}}$ bin [GeV]	$1/\sigma\, d\sigma/dp_T^{t\bar{t}}$	stat. [%]	sys. [%]	total [%]
0 to 20	$1.50 \cdot 10^{-2}$	4.1	11.8	12.5
20 to 45	$1.21 \cdot 10^{-2}$	3.5	7.0	7.8
45 to 75	$0.58 \cdot 10^{-2}$	3.8	9.2	10.0
75 to 120	$0.26 \cdot 10^{-2}$	4.3	14.0	14.6
120 to 190	$0.10 \cdot 10^{-2}$	4.5	7.8	8.9
190 to 300	$0.02 \cdot 10^{-2}$	6.3	18.0	19.1
$y^{t\bar{t}}$ bin	$1/\sigma\, d\sigma/dy^{t\bar{t}}$	stat. [%]	sys. [%]	total [%]
-2.5 to -1.3	$0.55 \cdot 10^{-1}$	6.4	10.8	12.5
-1.3 to -0.9	$2.17 \cdot 10^{-1}$	3.4	5.8	6.7
-0.9 to -0.6	$3.12 \cdot 10^{-1}$	3.6	4.4	5.7
-0.6 to -0.3	$4.00 \cdot 10^{-1}$	3.1	3.3	4.5
-0.3 to 0.0	$4.35 \cdot 10^{-1}$	3.1	4.1	5.1
0.0 to 0.3	$4.69 \cdot 10^{-1}$	2.8	3.8	4.8
0.3 to 0.6	$3.94 \cdot 10^{-1}$	3.1	5.9	6.7
0.6 to 0.9	$3.17 \cdot 10^{-1}$	3.4	4.7	5.8
0.9 to 1.3	$2.22 \cdot 10^{-1}$	3.3	5.8	6.6
1.3 to 2.5	$0.50 \cdot 10^{-1}$	6.8	9.7	11.9
$m^{t\bar{t}}$ bin [GeV]	$1/\sigma\, d\sigma/dm^{t\bar{t}}$	stat. [%]	sys. [%]	total [%]
0 to 345	-	-	-	-
345 to 400	$4.81 \cdot 10^{-3}$	5.2	9.7	11.1
400 to 470	$4.60 \cdot 10^{-3}$	5.0	8.4	9.8
470 to 550	$2.46 \cdot 10^{-3}$	5.2	10.2	11.4
550 to 650	$1.14 \cdot 10^{-3}$	5.6	10.6	12.0
650 to 800	$0.43 \cdot 10^{-3}$	6.2	8.3	10.3
800 to 1100	$0.99 \cdot 10^{-4}$	7.1	20.0	21.2
1100 to 1600	$0.14 \cdot 10^{-4}$	13.5	19.4	23.7

Table 4: Normalised differential $\mathrm{t\bar{t}}$ cross section as a function of lepton observables in the dilepton channels: the transverse momentum of the leptons p_{T}^{ℓ}, the pseudorapidity of the leptons η^{ℓ}, the transverse momentum of the lepton pair, $p_{\mathrm{T}}^{\ell\ell}$, and the invariant mass of the lepton pair $m^{\ell\ell}$.

p_{T}^{ℓ} bin [GeV]	$1/\sigma\,\mathrm{d}\sigma/\mathrm{d}p_{\mathrm{T}}^{\ell}$	stat. [%]	sys. [%]	total [%]
20 to 40	$1.92 \cdot 10^{-2}$	1.1	3.6	3.8
40 to 70	$1.27 \cdot 10^{-2}$	1.2	3.1	3.4
70 to 120	$0.38 \cdot 10^{-2}$	1.7	3.8	4.2
120 to 180	$0.07 \cdot 10^{-2}$	3.5	6.7	7.6
180 to 400	$0.32 \cdot 10^{-4}$	9.5	7.4	12.0
η^{ℓ} bin	$1/\sigma\,\mathrm{d}\sigma/\mathrm{d}\eta^{\ell}$	stat. [%]	sys. [%]	total [%]
-2.4 to -1.8	$0.07 \cdot 10^{-1}$	3.8	4.4	5.8
-1.8 to -1.2	$1.66 \cdot 10^{-1}$	2.3	3.4	4.1
-1.2 to -0.6	$2.65 \cdot 10^{-1}$	1.7	3.4	3.8
-0.6 to 0.0	$3.37 \cdot 10^{-1}$	1.6	3.2	3.5
0.0 to 0.6	$3.33 \cdot 10^{-1}$	1.6	3.2	3.6
0.6 to 1.2	$2.62 \cdot 10^{-1}$	1.8	3.4	3.8
1.2 to 1.8	$1.62 \cdot 10^{-1}$	2.3	3.4	4.1
1.8 to 2.4	$0.71 \cdot 10^{-1}$	3.6	4.4	5.7
$p_{\mathrm{T}}^{\ell\ell}$ bin [GeV]	$1/\sigma\,\mathrm{d}\sigma/\mathrm{d}p_{\mathrm{T}}^{\ell\ell}$	stat. [%]	sys. [%]	total [%]
0 to 10	$0.15 \cdot 10^{-2}$	9.2	11.8	15.0
10 to 20	$0.05 \cdot 10^{-2}$	4.8	6.5	8.0
20 to 40	$0.01 \cdot 10^{-2}$	2.8	4.0	4.8
40 to 60	$1.17 \cdot 10^{-2}$	2.2	3.5	4.1
60 to 100	$0.96 \cdot 10^{-2}$	1.7	3.4	3.8
100 to 150	$0.29 \cdot 10^{-2}$	2.8	5.2	5.9
150 to 400	$0.92 \cdot 10^{-4}$	7.0	10.3	12.5
$m^{\ell\ell}$ bin [GeV]	$1/\sigma\,\mathrm{d}\sigma/\mathrm{d}m^{\ell\ell}$	stat. [%]	sys. [%]	total [%]
12 to 50	$4.36 \cdot 10^{-3}$	2.3	4.4	4.9
50 to 76	$7.52 \cdot 10^{-3}$	2.2	5.1	5.6
76 to 106	$7.27 \cdot 10^{-3}$	2.1	5.8	6.1
106 to 200	$3.37 \cdot 10^{-3}$	1.6	3.5	3.9
200 to 400	$0.34 \cdot 10^{-3}$	3.6	5.7	6.7

Table 5: Normalised differential $\mathrm{t\bar{t}}$ cross section as a function of b-jet observables in the dilepton channels: the transverse momentum of the b jets $p_{\mathrm{T}}^{\mathrm{b}}$ and the pseudorapidity of the b jets η^{b}.

$p_{\mathrm{T}}^{\mathrm{b}}$ bin [GeV]	$1/\sigma\,\mathrm{d}\sigma/\mathrm{d}p_{\mathrm{T}}^{\mathrm{b}}$	stat. [%]	sys. [%]	total [%]
30 to 50	$1.28 \cdot 10^{-2}$	2.9	10.4	10.8
50 to 80	$1.25 \cdot 10^{-2}$	3.0	6.3	7.0
80 to 130	$0.54 \cdot 10^{-2}$	3.2	7.9	8.5
130 to 210	$0.10 \cdot 10^{-2}$	5.0	7.1	8.7
210 to 400	$0.49 \cdot 10^{-4}$	19.1	19.5	27.3
η^{b} bin	$1/\sigma\,\mathrm{d}\sigma/\mathrm{d}\eta^{\mathrm{b}}$	stat. [%]	sys. [%]	total [%]
-2.4 to -1.5	$0.98 \cdot 10^{-1}$	4.0	8.5	9.4
-1.5 to -0.8	$2.20 \cdot 10^{-1}$	3.0	4.0	5.0
-0.8 to 0.0	$3.12 \cdot 10^{-1}$	2.7	6.3	6.9
0.0 to 0.8	$3.05 \cdot 10^{-1}$	2.7	6.3	6.9
0.8 to 1.5	$2.20 \cdot 10^{-1}$	3.0	4.0	5.0
1.5 to 2.4	$1.10 \cdot 10^{-1}$	4.3	8.5	9.6

Table 6: Normalised differential $\mathrm{t\bar{t}}$ cross section as a function of top quark observables in the dilepton channels: the transverse momentum of the top quarks $p_{\mathrm{T}}^{\mathrm{t}}$, the rapidity of the top quarks y^{t}, the transverse momentum of the top-quark pair $p_{\mathrm{T}}^{\mathrm{t\bar{t}}}$, the rapidity of the top-quark pair $y^{\mathrm{t\bar{t}}}$, and the invariant mass of the top-quark pair $m^{\mathrm{t\bar{t}}}$.

$p_{\mathrm{T}}^{\mathrm{t}}$ bin [GeV]	$1/\sigma\,\mathrm{d}\sigma/\mathrm{d}p_{\mathrm{T}}^{\mathrm{t}}$	stat. [%]	sys. [%]	total [%]
0 to 80	$5.10 \cdot 10^{-3}$	2.2	5.6	6.0
80 to 130	$6.26 \cdot 10^{-3}$	2.6	3.9	4.7
130 to 200	$2.96 \cdot 10^{-3}$	2.6	4.9	5.6
200 to 300	$0.70 \cdot 10^{-3}$	3.5	6.2	7.1
300 to 400	$0.12 \cdot 10^{-3}$	7.5	5.4	9.3
y^{t} bin	$1/\sigma\,\mathrm{d}\sigma/\mathrm{d}y^{\mathrm{t}}$	stat. [%]	sys. [%]	total [%]
-2.5 to -1.3	$0.91 \cdot 10^{-1}$	4.1	6.8	8.0
-1.3 to -0.8	$2.55 \cdot 10^{-1}$	3.1	4.9	5.8
-0.8 to -0.4	$3.02 \cdot 10^{-1}$	3.3	4.0	5.2
-0.4 to 0.0	$3.51 \cdot 10^{-1}$	3.2	3.8	5.0
0.0 to 0.4	$3.71 \cdot 10^{-1}$	3.2	3.8	4.9
0.4 to 0.8	$3.06 \cdot 10^{-1}$	3.4	4.0	5.3
0.8 to 1.3	$2.41 \cdot 10^{-1}$	3.3	4.9	5.9
1.3 to 2.5	$0.90 \cdot 10^{-1}$	4.0	6.8	7.9
$p_{\mathrm{T}}^{\mathrm{t\bar{t}}}$ bin [GeV]	$1/\sigma\,\mathrm{d}\sigma/\mathrm{d}p_{\mathrm{T}}^{\mathrm{t\bar{t}}}$	stat. [%]	sys. [%]	total [%]
0 to 20	$1.60 \cdot 10^{-2}$	2.9	24.9	25.0
20 to 60	$0.97 \cdot 10^{-2}$	2.1	10.7	10.9
60 to 120	$0.32 \cdot 10^{-2}$	2.5	13.2	13.5
120 to 300	$0.05 \cdot 10^{-2}$	3.7	6.9	7.9
$y^{\mathrm{t\bar{t}}}$ bin	$1/\sigma\,\mathrm{d}\sigma/\mathrm{d}y^{\mathrm{t\bar{t}}}$	stat. [%]	sys. [%]	total [%]
-2.5 to -1.5	$0.30 \cdot 10^{-1}$	13.7	14.7	20.1
-1.5 to -0.7	$2.19 \cdot 10^{-1}$	3.1	4.4	5.4
-0.7 to 0.0	$4.18 \cdot 10^{-1}$	2.4	3.6	4.3
0.0 to 0.7	$3.93 \cdot 10^{-1}$	2.5	3.6	4.4
0.7 to 1.5	$2.18 \cdot 10^{-1}$	3.2	4.4	5.5
1.5 to 2.5	$0.40 \cdot 10^{-1}$	10.4	14.7	18.0
$m^{\mathrm{t\bar{t}}}$ bin [GeV]	$1/\sigma\,\mathrm{d}\sigma/\mathrm{d}m^{\mathrm{t\bar{t}}}$	stat. [%]	sys. [%]	total [%]
0 to 345	-	-	-	-
345 to 400	$5.26 \cdot 10^{-3}$	5.4	10.4	11.7
400 to 470	$4.58 \cdot 10^{-3}$	3.8	4.1	5.6
470 to 550	$2.46 \cdot 10^{-3}$	4.9	7.6	9.0
550 to 650	$1.07 \cdot 10^{-3}$	6.1	3.9	7.2
650 to 800	$0.39 \cdot 10^{-3}$	6.9	11.4	13.4
800 to 1100	$0.08 \cdot 10^{-3}$	13.3	27.0	30.1
1100 to 1600	$0.01 \cdot 10^{-3}$	22.4	43.6	49.0